Wireless Passive Nanoparticle based Intelligent Sensor System for Extreme Environments, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

Sensatek Propulsion Technology, Inc. proposes to demonstrate the feasibility of a wireless, passive, nanoparticle-based sensor system. The sensor in its current form can be used to measure real time temperatures and pressures wirelessly without the need of an external energy source. It should be noted that the same sensing principle can be used for strain monitoring as well. It comprises of a microwave-resonator-based sensor, a microwave transceiver, and a custom-made antenna. The microwave-resonator-based sensors uses a dielectric resonator structure, a low-profile reflective patch temperature sensor, and a pressure sensor based on evanescent-mode resonator structure. These sensors are made of high-temperature-stable and corrosion-resistant ceramic materials which are suitable for extreme-environment applications. The use of nanoparticles can further reduce the size of the sensor enabling deployment in current hard-to-access areas.

This approach will enable not only surface measurements of pressure and temperature but also provide in-flow measurements of gas path flows at cryogenic and high temperature environments. In-flow measurements within the metal piping of the fluid systems helps provide a dynamic and real time analysis of the operations of the system. Besides, the embedded sensor helps in keeping the structural integrity of the component intact since it's installation doesn't require machining pathways as is needed for traditional sensor cables.

The proposed innovation will specifically provide the following benefits for propulsion system test, development & flight applications:

- Reduced cabling costs/time
- Reduced auxiliary power requirements
- Reduced weight penalties/operational costs associated with cabling and auxiliary power components
- Remote, real-time monitoring of component health
- Flexible application due to low profile of sensor
- Extreme environment measurement & survivability

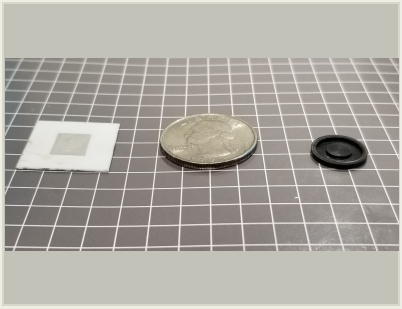
Anticipated Benefits

-Reduced cost and labor requirements associated with instrumentation installation at 8-Foot High-Temperature Tunnel Facility for National Aerospace Plan Concept Demonstration Engine, X43 Hyper-X engine

-Reduce operational costs for various engine test-beds, developmental & launch facilities at SSC, GRC, MSFC and KSC Propulsion Systems Laboratory

-Structural health monitoring into the numerous NASA programs particularly the RS-25 engines on SLS.

Monitoring of harsh environments in inaccessible locations provides insight to increase the reliability and efficenciy in systems that includes: HyFly Dual



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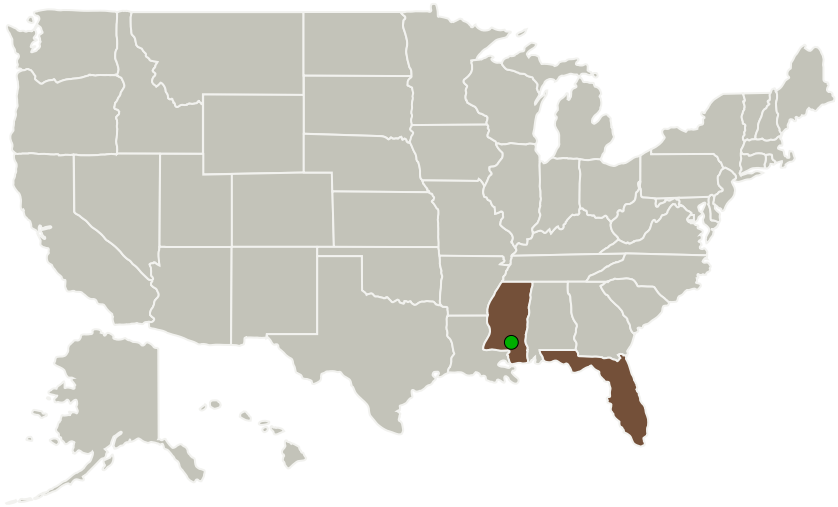
Combustor Ramjet Engine, X43C program's Ground Demonstrator, Air Force Research Laboratory's SJX61–1 and SJX61–2 engines; Power Generation & Aviation Gas Turbine Engines for Maintenance & Operational Monitoring; Automotive for Continuous Monitoring for Component Health Indication; and Chemical Plants for Process Control, Safety & Automation.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Sensatek Propulsion Technology, Inc	Lead Organization	Industry Minority-Owned Business, Small Disadvantaged Business (SDB), Veteran-Owned Small Business (VOSB)	Tallahassee, Florida
Florida State University(FSU)	Supporting Organization	Academia	Tallahassee, Florida
Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Sensatek Propulsion Technology, Inc

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

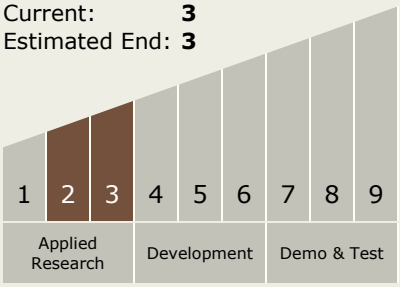
Carlos Torrez

Principal Investigator:

Reamonn Soto

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Completed Technology Project (2018 - 2019)

Primary U.S. Work Locations	
Florida	Mississippi

Project Transitions

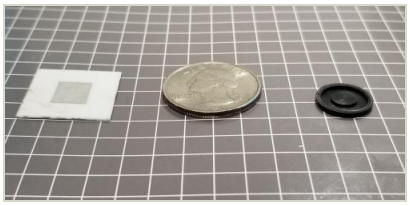
July 2018: Project Start

August 2019: Closed out

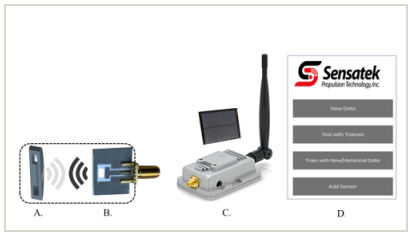
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140149)*

Images



Briefing Chart Image
Wireless Passive Nanoparticle based Intelligent Sensor System for Extreme Environments, Phase I *(https://techport.nasa.gov/image/136459)*



Final Summary Chart Image
Wireless Passive Nanoparticle based Intelligent Sensor System for Extreme Environments, Phase I *(https://techport.nasa.gov/image/136381)*

Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
  - TX13.4 Mission Success Technologies
    - TX13.4.5 Operations, Health and Maintenance for Ground and Surface Systems

Target Destination

Earth